Energy, Mines and Resources Canada | Énergie, Mines et Ressources Canada

CANMET

Canada Centre for Mineral and Energy Technology | Centre canadien de la technologie des minéraux et de l'énergie

USE OF A MICROPROCESSOR CONTROLLED COAL ANALYZER TO EVALUATE MINE ROADWAY DUST SAMPLES

D.J. Kennedy and G. Bonnell
Cape Breton Coal Research Laboratory

October 1984

This document is an unedited interim report prepared primarily for discussion and limited reporting purposes. It does not represent final evaluation, nor necessarily the opinion of the Canada Centre for Mineral and Energy Technology (CANMET).

Ce document est un rapport provisoire et rédigé [illegible] pour fin de discussion et de [illegible] information [illegible] ne représente nulle-ment une évaluation définitive de [illegible] du Centre canadien de la technologie des minéraux et de l'énergie (CANMET).

14 pp

ENERGY RESEARCH PROGRAM
COAL RESEARCH LABORATORIES
DIVISION REPORT 84-30(IR)

MICROMEDIA

85-0535/

USE OF A MICROPROCESSOR CONTROLLED COAL ANALYZER TO EVALUATE MINE ROADWAY DUST SAMPLES

by

D. Kennedy* and G. Bonnell**

INTRODUCTION

As coal is mined, fine coal dust is produced. This fine coal dust represents a serious fire and explosion hazard unless it is sufficiently diluted with inert material or prevented from being dispersed in air by salt crusting. The current method used to render mine roadway dust nonexplosive in the Sydney Coalfiled is the application of fine inert limestone dust.

Sampling of mine roadway dust is done on a regular basis to ensure that sufficient inert dust is present to prevent a coal dust explosion from propagating.

INTRODUCTION

Lorsqu'on extrait le charbon, une fine poussière de charbon se dégage. Cette poussière présente des risques sérieux d'incendie et d'explosion à moins qu'on ne l'ait suffisamment diluée à l'aide de matière inerte ou qu'on ne l'empêche de se disperser dans l'air au moyen d'une couche de sel. La méthode actuelle pour prévenir les risques d'explosion provenant de la poussière de la chaussée des mines à la houillère de Sydney consiste dans l'application d'une fine poussière de calcaire inerte. On procède régulièrement à l'échantillonnage de la poussière de la chaussée des mines afin d'assurer que la poussière inerte est présente en quantité suffisante pour prévenir la propagation d'une explosion de poussière de charbon.

---

*Environmental Technologist, **Supervising Chemist, Cape Breton Coal Research Laboratory, CRL, CANMET, Energy, Mines and Resources Canada, Sydney.

CONTENTS

	Page
INTRODUCTION	1
METHODS OF ANALYSIS	1
Fisher Model 490 Coal Analyzer	2
DISCUSSION OF RESULTS	2
CONCLUSIONS	3
APPENDIX A	8
APPENDIX B	10

TABLES

No.		
1.	Standard samples prepared from Lingan coal dust	4
2.	Standard samples prepared from Prince coal dust	5

FIGURES

1.	Percentage of stone dust - Lingan	6
2.	Percentage of stone dust - Prince	7

METHODS OF ANALYSIS

The following methods are currently used for the analysis of mine roadway dust samples.

1. High temperature ashing
2. Low temperature ashing
3. Volumetric
4. Colorimetric

Both high temperature and low temperature ashing are chemical methods enabling a precise measure of the inert content of the dust sample to be obtained. Low temperature ashing is not appropriate for dusts containing magnesium carbonate since this substance decomposes below 500 degrees celcius - the temperature used in this method. It should be noted, however, that the error involved would be on the safe side, ie lower inert than actually present.

In the past, preference has been given to the volumetric and colorimetric methods of analyses because, although less accurate, both were more rapid than the chemical methods. Recent advances in electronic balances and microprocessors have seen the introduction of automatic coal analyzers. These instruments are well suited for the automatic determination of the inert content of mine roadway dusts, by the low temperature ash method.

Fisher Model 490 Coal Analyzer

This report describes the use of a Fisher Model 490 Coal Analyzer for analyzing mine roadway dust samples. Performance characteristics and specifications are given in Appendix A. The Fisher instrument consists of a compact bench-top unit containing all the equipment necessary for low temperature ash analysis. The model 490 incorporates two desiccator chambers, a forced air drying oven for moisture determination, and a forced air muffle furnace for ashing. The control panel includes a processor keyboard for program and data entry. Sample weights are automatically entered from an electronic balance via an integral weight transfer interface. A printer module provides a permanent record of each sample analysis.

In addition to saving analysis time by eliminating laborious hand recording and data manipulation the microprocessor also removes associated operator bias and error.

DISCUSSION OF RESULTS

A standard analytical procedure for low temperature ashing is shown in Appendix B. 100 gram standard mixtures by weight of stonedust and coal dust were prepared using an analytical balance accurate to 0.0001 grams.

Table 1 shows the results of a series of 12 mixtures of stonedust and coal dust. The coal dust was a minus 60 mesh sample from Lingan Mine mixed with typical limestone dust used for inerting purposes in that mine.

Table 2 shows the results of another series of 12 samples. Minus 60 mesh coal dust from Prince Mine was mixed in varying proportions with typical limestone dust used for inerting in that mine.

Analytical results were obtained using the previously described Fisher Model 490 Coal Analyzer.

The results reported in tables 1 and 2 were determined by a single routine analysis of each sample. More accurate results could be obtained by averaging the results of duplicate or triplicate analysis on each sample.

It is evident from tables 1 and 2 and figures 1 and 2 that the stonedust presently being used by the Cape Breton Development Corporation contains little, if any, magnesium carbonate. If another type or another supplier of limestone dust is anticipated, samples of that limestone should be analyzed to ensure that no magnesium carbonate is present.

CONCLUSIONS

Automated coal analyzers incorporating electronic balances and microprocessors are well suited for performing low temperature ash analysis on mine roadway dust samples.

The maximum analytical error using the automated low temperature ashing method was considerably less than the errors expected from the more labour intensive volumetric methods and significantly less than the field sampling errors inherent in the sample collection process.

On the basis of these preliminary analyses, automated low temperature ashing offers a rapid accurate alternative to the more classical labour intensive methods.

Table 1 - Standard samples prepared from Lingan coal dust

Sample #	%Stonedust	%Inert (theoretical)	%Inert (analytical result)	Error in %Inert (analytical)
1	100	-	99.7	-
2	99	98.8	98.8	0.0
3	98	97.8	97.9	+0.1
4	95	95.0	95.0	0.0
5	90	90.2	90.5	+0.3
6	85	85.5	84.6	-0.9
7	80	80.7	80.7	0.0
8	75	76.0	76.4	+0.4
9	70	71.2	71.5	+0.3
10	65	66.4	66.7	+0.3
11	60	61.7	62.0	+0.3
12	50	52.2	52.6	+0.4
13	25	28.4	28.7	+0.3
14	0	-	4.6	-

Table 2 - Standard samples prepared from Prince coal dust

Sample #	%Stonedust	%Inert (theoretical)	%Inert (analytical result)	Error in %Inert (analytical)
1	100	-	99.7	-
2	99	98.9	98.9	0.0
3	98	98.0	98.0	0.0
4	95	95.3	95.5	+0.2
5	90	90.9	91.1	+0.2
6	85	86.5	86.8	+0.3
7	80	82.1	82.3	+0.2
8	75	77.7	77.8	+0.1
9	70	73.3	73.7	+0.4
10	65	68.9	69.0	+0.1
11	60	64.5	64.8	+0.3
12	50	55.7	55.3	-0.4
13	25	33.7	34.7	+1.0
14	0	-	11.6	-

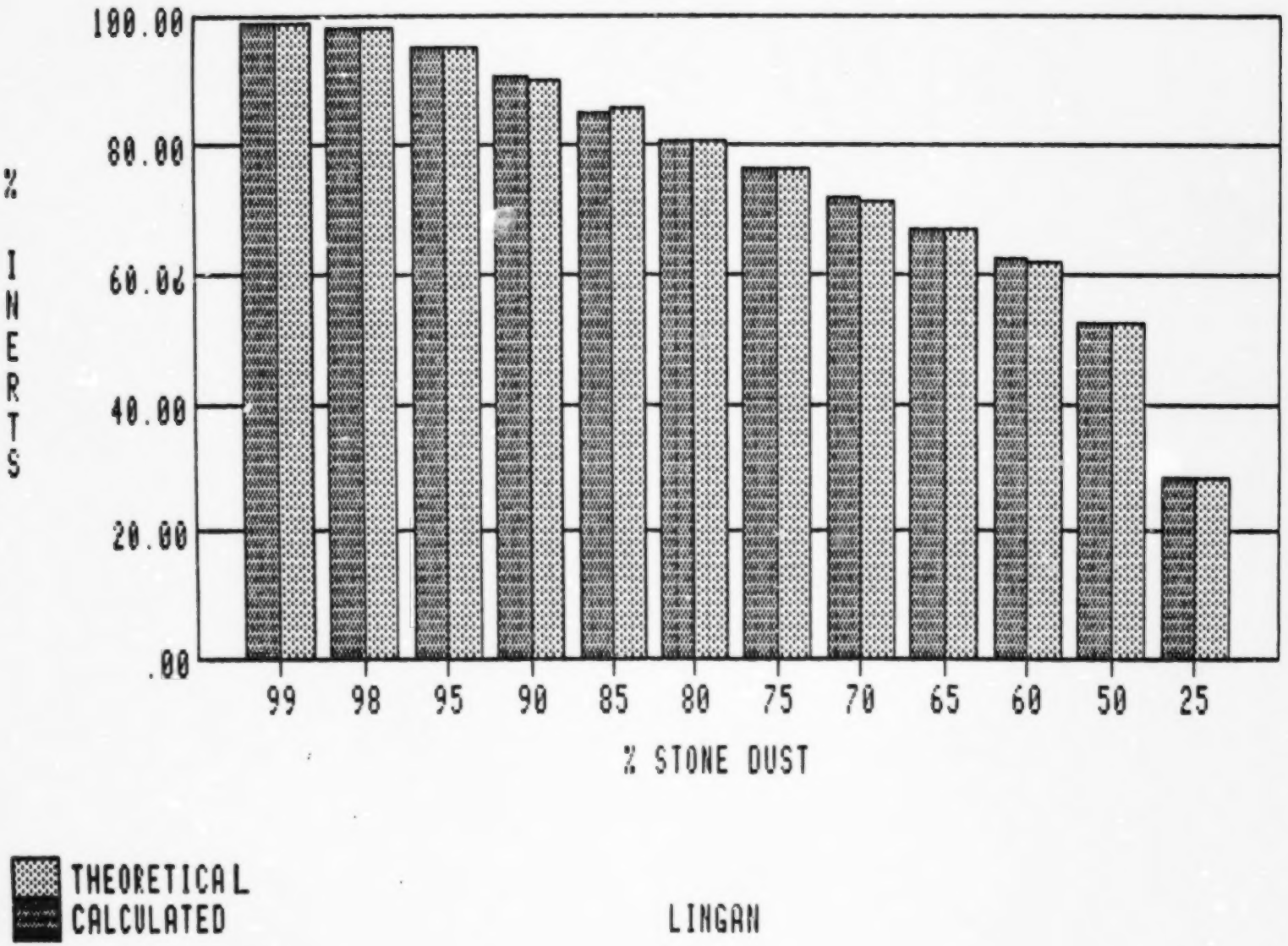


Fig. 1 - % Stone dust

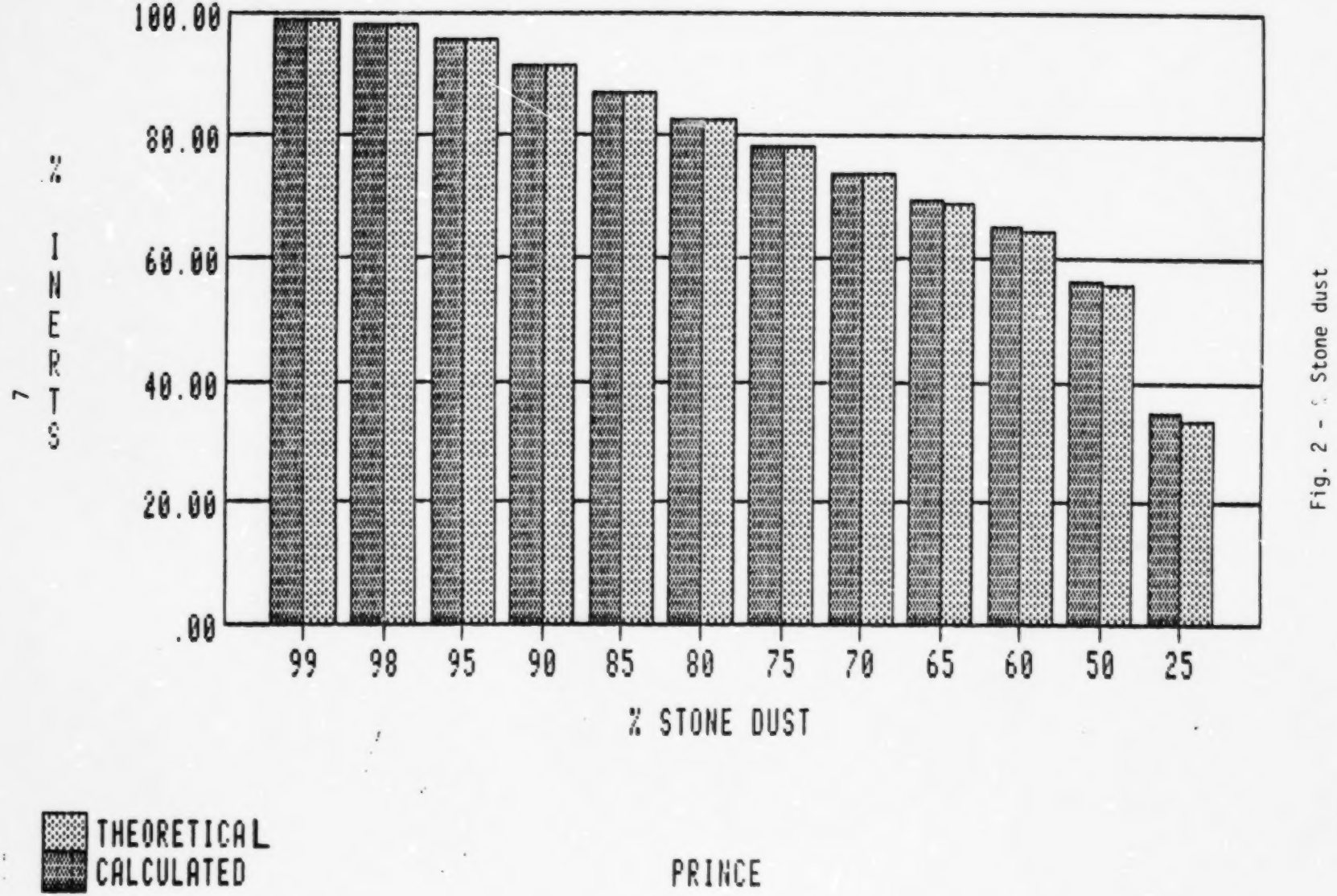
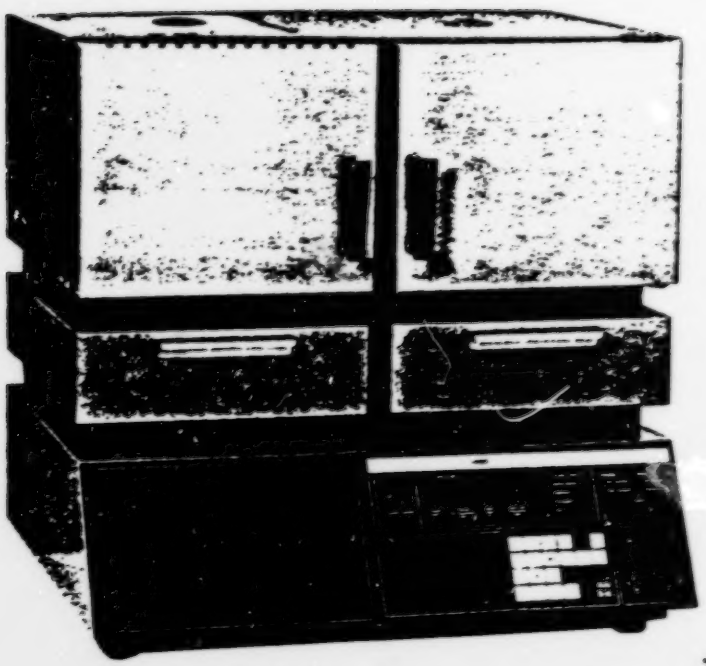


Fig. 2 - % Stone dust

APPENDIX A

Fisher Model 490 Coal Analyzer



The Analyzer Module

The Printer Module

PERFORMANCE CHARACTERISTICS

Furnace:	
Temperature Range	Ambient to 1000°C, selectable in 1°C increments.
Heating Rates	Variable between 1°C and 35°C per minute.
Temperature Accuracy	<±2%
Oven:	
Temperature Range	Ambient to 140°C, selectable in 1°C increments. (Processor automatically maintains oven at 107°C if no other temperature is entered.)
Temperature Accuracy	<±2%

SPECIFICATIONS

Power Requirements	230V ac ±10%, 50/60 Hz
Furnace Type	Muffle (static-air for volatiles, forced-air for ashing with four exchanges per minute).
Furnace Capacity	40 samples maximum.
Oven Type	Forced-air (four exchanges per minute).
Oven Capacity	40 samples maximum.
Microprocessor	F8 system, with central processing unit (CPU) and two peripheral input/output (PIO) units.
Printer	Dot-matrix type slaved to Model 490.
Dimensions:	
Analyzer	65.3L x 68.8W x 63.5 cmH (25 x 27 x 25 in.)
Printer	35L x 24W x 15 cmH (13.8 x 9.5 x 5.5 in.)
Approximate Shipping Weight:	
Analyzer	90.7 kg (200 lb)
Printer	7.1 kg (16 lb)
Construction	Cold-rolled steel with citron grey baked enamel finish. Stainless steel chamber interiors. Trim and control panel finished in charcoal grey enamel.

APPENDIX B

DETERMINATION OF INCOMBUSTIBLE MATTER BY THE LOW TEMPERATURE INCINERATION METHOD

The mine road dust is incinerated at a temperature of not less than 500°C and not more than 530°C until it is constant in weight. In a well ventilated muffle furnace this temperature is sufficient to complete the combustion of the organic matter in the dust, but not high enough to decompose the carbonates. This method is unsuitable for dust containing magnesium carbonate, since this substance decomposes below 500°C, and therefore a low result for the incombustible matter would be obtained. Magnesium carbonate may be present in the dust in amounts up to that corresponding with pure dolomite ($CaCO_3 \cdot MgCO_3$).

The moisture content of the sample may be determined so that an allowance can be made for the weight loss attributable to moisture.

Equipment

Oven: An air oven capable of maintaining a temperature not exceeding 140°C.

Dishes: Silica dishes either circular (approx. 40 mm. diameter) or retangular (approx. 60 mm. x 30 mm.).

Procedure

Weigh lg. of dust in a weighed silica dish and dry for one hour at a temperature not exceeding 140 °C. Cool, cover, reweigh the dish and express the loss in weight per cent as moisture.

DETERMINATION OF RESIDUE AFTER LOW-TEMPERATURE INCINERATION

Equipment

Furnace: A well-ventilated muffle furnace capable of maintaining a temperature of 500 + 30°C.

Dishes: Silica dishes as used for moisture determination.

Procedure

Place the dish containing the residue from the moisture determination (or a 1g. sample of the dust in a weighed silica dish if no moisture determination is being carried out) in the furnace and raise the temperature to 500 + 30°C. Continue the ignition until no further loss of weight occurs. The time required is 1-2 hours. Remove the dish from furnace, cool, reweigh and express the residue as per cent residue after low-temperature ignition.

REPORTING OF RESULTS

$$\text{Percentage incombustible matter} = \frac{a + b}{w} \times 100$$

where a = wt. of incinerated residue

b = wt. of moisture in sample.

w = wt. of sample taken

POOR

QUALITY

ORIGINAL